



## Physical activity

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To read the Key Messages related to this topic, consult the Encyclopedia at :  
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## Synthesis on physical activity

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### How important is it?

Child obesity is a growing problem in many nations. In 2005, the number of overweight children under the age of 5 was approximately [20 million](#). Despite common beliefs that children are naturally active, [rates of physical activity](#) are low in several countries. In fact, behaviours associated with a [sedentary lifestyle](#) are often common place in the daily routine of young children. Sedentary behaviours, such as television viewing and playing computer games, typically require [little energy expenditure](#). These behaviours are not necessarily in opposition to physical activity because a child who engages in physical activity can also spend a significant amount of time in sedentary behaviours. However, given that sedentary living might have long-term [negative health consequences](#) and that physical activity is beneficial to children's health and development, it is important to find ways to encourage children to develop a healthy lifestyle from an early age.

### What do we know?

[Sedentary activities](#) are often introduced early on in the infant's daily routine, and have a tendency to increase steadily from infancy to the preschool years, whereas rates of physical activity tend to be low both at home and in the child care setting. However, these rates also vary across studies and depending on the measurement tool used to assess physical activity. A recent U.S. report estimated that the average preschool child spent 320 minutes per day engaging in physical activity. In contrast, the use of an [objective measure](#) in a different study conducted in Australia and Portugal revealed that preschoolers spent 110 to 120 minutes daily engaging in physical activity.

#### *Factors associated with physical activity*

Several factors are related to physical activity. Boys and girls who have active parents and who spend a lot of [time outdoors](#) are typically the most physically active. [Predictors](#) of physical activity vary depending on both the child's characteristics (e.g., age) and the [settings/contexts](#) (e.g., home vs. child care). For example, in preschool, kindergarten and child care settings, children are most active 1) when they play in an unconstrained environment 2) when the duration of recess is shorter, and 3) when the staff is trained to engage children in physical activity. Providing children with [play equipments](#) that are both fixed and portable and with opportunities to engage in physical activity also increase their engagement.

### *Outcomes*

Physical inactivity in young children is a risk factor for many [health problems](#) such as high blood pressure, weight gain, excess body fat, bad cholesterol, respiratory difficulties, cardiovascular diseases and bone health problems.

The [health benefits](#) of physical activity on child development extends much beyond physical health as it also impacts the domains of motor skills, psychological well-being, social competence and emotional maturity. In contrast, sedentary behaviours are considered to pose a threat to young children's cognitive development. Preschool children who watch a lot of television are likely to experience [cognitive difficulties](#) in the school years, including attention deficits, poor language skills, low school achievement, and a short memory span (i.e., a list of items a person can retain).

### **What can be done?**

To encourage children to develop an active lifestyle, different organizations advise limiting the amount of time children spend in sedentary behaviours, and promoting physical activity in the family and in the child care setting. For example, American and Australian organizations [recommend](#) that children under 2 not watch television, and that those between 2 and 5 be limited to 1 to 2 hours per day. Given that the exact amount required for physical activity to be beneficial for children still remains to be determined, minimal daily standards vary across nations. In Australia, authorities recommend [three hours](#) of physical activity distributed across the day for both toddlers and preschoolers, with no specified intensity to allow room for children's [natural dispositions](#). Meanwhile, U.S. guidelines are more specific and recommend that toddlers and preschoolers be involved in daily structured physical activity for 30 and 60 minutes respectively, whereas at least one hour of their day should be dedicated to unstructured physical activity (e.g., climbing on a play structure), a duration that can be extended up to several hours.

Parents can encourage their child's participation in physical activity by being [role models](#) who provide every opportunity for the child to be active, such as going for short walks instead of stroller rides, and who limit time spent in sedentary behaviours. Parents are also responsible for providing [safe and risk-free environments](#) both indoors and outdoors where their child can be physically active. Parents should make sure to give [equal opportunities](#) to both sons and daughters to be physically active. To enhance physical activity at home, policy makers should make [parental education and support](#) a priority. In the child care setting, physical activity can be enhanced by integrating physical exercises of varying intensity both indoors and outdoors in children's daily routine, and by making these activities more [enjoyable](#). Children should be provided with a proper size outdoor space including shaded areas and portable equipment. [Training](#) child care professionals in integrating physical activity within the curriculum has also been found to be a winning strategy to promote children's engagement.



## Levels of Habitual Physical Activity in Early Childhood

*DYLAN P. CLIFF, PhD*  
*XANNE JANSSEN, MSc*

*University of Wollongong, AUSTRALIA*

*(Published online January 12, 2011)*

### **Topic**

*Physical activity*

### **Introduction**

Preventable lifestyle diseases continue to be major contributors to the burden of disease internationally, and physical inactivity is among the top five risk factors contributing to global mortality.<sup>1</sup> Intervention during the earliest developmental years might be required to ensure health promoting behaviours, such as physical activity, are established.<sup>2</sup> Despite being the most active segment of the population, monitoring studies<sup>3-9</sup> suggest that a high proportion of young children may be insufficiently active for adequate development and health.

### **Subject**

Physical activity is typically categorized into different intensities and is measured in metabolic equivalents (METs; 1 MET is equivalent to rest).<sup>10</sup> Light intensity physical activities (1.5-2.9 METs) for young children include dressing up in costumes, standing and painting, and slow walking. Moderate-to-vigorous physical activities (MVPA)(3-8 METs) include those of a higher intensity, such as running, jumping, and playing ball games. Sedentary behaviours (<1.5 METs) are those characterized by sitting or lying down, and include TV viewing, using a computer, reading, and drawing. Young children's natural activity patterns are described as intermittent, and are characterized by cycles of short intense bursts of activity followed by periods of rest or lower intensity activity.<sup>3</sup> This activity should predominantly occur through active play.<sup>11</sup>

Physical activity has beneficial effects on health and development in the early years of life<sup>3</sup> and contributes to the prevention of obesity<sup>12</sup> and cardiovascular disease risk factors,<sup>13-15</sup> adequate bone<sup>16</sup> and motor development,<sup>17</sup> and positive cognitive and social development.<sup>11</sup> Activity patterns also appear to track during childhood,<sup>14,18</sup> and from childhood and adolescence to adulthood,<sup>19</sup> suggesting that early life experiences of physical activity may shape later behaviour and subsequent health.

Although there is consensus that “more physical activity is better,” there is insufficient evidence of the precise “dose” or amount and intensity of physical activity required for adequate health and development in early childhood.<sup>3</sup> For this reason, the amount of physical activity specified in recommendations for toddlers (1 to 3 years) and preschoolers

(3 to 5 years) differ slightly between the United States and Australia. The National Association for Sport and Physical Education (NASPE) guidelines in the U.S. recommend that toddlers should accumulate at least 30 minutes of structured and at least 60 minutes to several hours of unstructured physical activity daily, while preschoolers should accumulate at least 60 minutes of structured and at least 60 minutes to several hours of unstructured physical activity daily.<sup>20</sup> In Australia the recommendations specify that toddlers and preschoolers should be physically active every day for at least three hours, spread throughout the day.<sup>21</sup> As it is unclear if this activity needs to be of a specific intensity for health benefits to occur,<sup>3</sup> physical activity for this age group includes all daily movements at both light and moderate-to-vigorous intensities.

### **Problems and Research Context**

Difficulties in accurately measuring the unique physical activity patterns of young children have delayed progress in this area. Self-reports are inappropriate and parent-proxy reports have inherent biases.<sup>22,23</sup> In part, this is because young children's physical activity does not occur in easily distinguishable blocks of exercise as is typical among adults. Direct observation offers a more objective approach, however this is only appropriate for confined settings, such as the child care centre/preschool.<sup>22</sup> [Accelerometers](#) are feasible, acceptable and have adequate validity and reliability for assessing physical activity among youth, and because they collect objective, real-time data and are adequately sensitive to low intensity movements they are particularly suitable for use with young children.<sup>24,25</sup> One limitation of [accelerometry](#) is that the most accurate cut-points for defining sedentary behaviour, light physical activity and MVPA have not yet been established among preschoolers,<sup>25</sup> and the use of different definitions can have substantial effects on prevalence estimates.<sup>24,26</sup>

### **Key Research Questions**

Research using accelerometry has investigated young children's habitual physical activity levels over the course of a typical week, and specifically when at child care/preschool. These studies have also attempted to quantify the amount of time preschoolers spend in light physical activity and MVPA, and some have investigated compliance with physical activity guidelines.

### **Recent Research Results**

Findings from studies using accelerometry offer important insights into young children's physical activity patterns. These studies indicate that 3- to 5-year-olds spend approximately 60 minutes per day in MVPA (range: 20-90 minutes),<sup>3-7</sup> equating to around 8% (range: 3%-12%)<sup>3-7</sup> of their 13 or so daily waking hours.<sup>27</sup> Additionally, young children appear to accumulate a substantial amount of light intensity physical activity: around 80-150 minutes per day or 11% to 20% (range: 5%-33%) of their waking hours.<sup>3-7</sup> Therefore current estimates suggest that preschool-aged children spend a total of approximately 2 to 3½ hours per day in physical activity. It is plausible to assume that much of this activity might take place during child care/preschool, although a recent review of 13 studies that used objective measures concluded that young children's typical levels of physical activity within child care centers were low and would have led to the accumulation of <60 minutes per day of MVPA.<sup>8</sup>

It is important to note that substantial variation or inconsistency exists between studies. Recent reports from Australia<sup>4</sup> and Portugal<sup>5</sup> suggested that preschool children's objectively measured total activity time was 110-120 minutes per day, whereas data from another study in the United States indicated that preschool children spent approximately 320 minutes per day in activity.<sup>6</sup> Estimates of compliance with physical activity guidelines also vary. For example, in one Australian study 56% and 79% of preschoolers spent  $\geq 3$  hours per day in physical activity on weekdays and weekend days, respectively, according to parent reports.<sup>28</sup> In contrast, only 74% of preschoolers spent  $\geq 2$  hours per day in physical activity measured using accelerometry in another study of Portuguese children.<sup>5</sup> Likewise, a recent review of 39 studies concluded that only approximately 54% of young children achieved  $\geq 60$  minutes per day of MVPA.<sup>9</sup> Methodological issues, such as the application of different measurement instruments, the use of different definitions for physical activity intensities, and differences in the interpretation of guidelines, have clearly influenced our understanding of physical activity patterns during the early years.

### **Research Gaps**

As the development of physical activity guidelines for the early years has only recently been undertaken or is currently in progress in several countries, such as Australia and the United Kingdom, nationally representative data are not yet available. National monitoring surveys are urgently needed to understand more precisely how active young children are, and to ascertain the proportion of the early childhood population achieving the recommended amount of physical activity each day. Very little data are currently available for children under three years of age, and it is unclear if specific socio-demographic groups are in particular need of support to meet guidelines. Despite the existence of guidelines, there is not yet consensus on the precise amount and intensity of physical activity required for optimum health and development in the early years, resulting in different recommendations in the United States compared with Australia. Thus, research on the relationships between objectively measured physical activity and developmental and health outcomes is still needed.

### **Conclusions**

Physical activity plays an important role in young children's health and development, however contemporary lifestyles and environments appear to be preventing some young children from engaging in adequate levels of physical activity. As the origins of an active lifestyle begin in the early years of life, physical inactivity during early childhood might have consequences for children's current and future health, behaviour, social and emotional development, and cognitive function.

### **Implications for Parents, Services and Policy**

Influential people and institutions in the lives' of young children must ensure they receive adequate opportunities to engage in the recommended amount of developmentally-appropriate and health-enhancing physical activity. This should occur through unstructured active play and structured learning experiences, in the home and child care centres, through active transportation, and in socially- and culturally-accepted and enjoyable ways. National surveillance systems are required to accurately describe

children's activity levels and patterns during the early years and to determine if targeted interventions are required for specific segments of the population.

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*child development*





## Physical Activity Recommendations for Early Childhood

*RACHEL A. JONES, PhD*  
*ANTHONY D. OKELY, EdD*

*University of Wollongong, AUSTRALIA*

*(Published online January 13, 2011)*

### **Topic**

*Physical activity*

### **Introduction**

Early childhood has been identified as a critical time for the development of healthy behaviours, such as physical activity.<sup>1</sup> A rationale for promoting physical activity is that it provides the milieu for movement skills to develop, with movement, particularly physical activity play, being the substrate for physical activity during early years and subsequent years leading into adolescence and adulthood.<sup>2</sup>

### **Subject and Research Context**

Physical activity recommendations for children from birth to five years have been developed across a number of countries,<sup>3-7</sup> with the majority of recommendations being “policy-oriented” statements providing anticipatory guidance for parents, health and educational professionals. These “statements” can be summarized as follows:

Physical activity is a natural and life-long activity that should be encouraged from birth. Parents and/or caregivers are encouraged to be positive role models and provide daily physical activity opportunities incorporating developmentally-appropriate activities which promote motor skills. Both structured and unstructured physical activity opportunities should be provided in safe indoor and outdoor environments and the emphasis should be on “fun” and “participation” rather than competition.

Although these general descriptive recommendations are potentially helpful they have several limitations, for example, the absence of a prescribed amount of daily physical activity. Quantitative prescriptive guidelines offer a number of advantages over descriptive guidelines including facilitation of ongoing monitoring and surveillance of physical activity levels in children.<sup>3</sup>

### **Problems and Key Research Questions**

To date, few countries have prescribed quantitative guidelines for physical activity in children younger than 5 years.<sup>3,4</sup> The aim of this chapter is to summarize the empirical research supporting recently developed physical activity recommendations for children birth to 5 years of age. The key research questions addressed in this chapter are:

1. Is there any evidence that physical activity is associated with health outcomes in early childhood?
2. Based on the evidence, how much time should young children spend in physical activity?

### **Recent Research Results**

Over 140 cross-sectional, prospective cohort studies, quasi-experimental and experimental studies were reviewed.<sup>3,4</sup> Studies were included if they met a specific inclusion criteria which was based on the Method of Critical Evaluation recommended by the Australian National Health and Medical Research Council.<sup>8</sup> Identified studies were categorized according to the strength of evidence that they provided. Four domains of evidence were investigated: physical activity and related health outcomes; tracking of physical activity; descriptive epidemiology; and correlates of physical activity. (Similar approaches were used by Okely and Jones<sup>9</sup>). The evidence for the health related outcomes are summarized in this review, with the others being summarized in subsequent reviews on the topic of physical activity.<sup>9-14</sup>

Physical activity participation can provide important health benefits such as preventing unhealthy weight gain, reducing blood pressure and enhancing mental health.<sup>15,16</sup> The association between physical activity and several health outcomes (adiposity, musculoskeletal health, motor development, blood lipids and social and emotional development) were investigated.

A moderate association between physical activity and body fatness was found. Thirty studies were identified, with all seven prospective cohort studies showing that those who were more active at baseline had smaller gains in fatness at follow-up.<sup>17-23</sup> Of the 19 cross-sectional studies identified, 11 reported a significant inverse relationship between physical activity and adiposity.<sup>24-34</sup> This relationship was much stronger when an objective measure of physical activity was used.

A limited association between physical activity and blood pressure, musculoskeletal health and motor development was found. Of the four studies reporting the relationship between physical activity and blood pressure, one prospective cohort study found that those with higher increases in physical activity had smaller increases in systolic and diastolic blood pressure<sup>35</sup> while two cross-sectional studies showed positive associations between physical activity and diastolic blood pressure.<sup>36,37</sup> Five studies were identified that reported associations between physical activity and musculoskeletal health, however three involved a non-representative preschool population (pre-term infants with very low birth weight).<sup>38-40</sup> A cross-sectional study by Janz et al<sup>41</sup> showed that vigorous-intensity physical activity was significantly related to bone mineral content and bone mineral density (two indicators of bone health). Five cross-sectional studies reported associations between physical activity and motor development.<sup>42-46</sup> Although all of these reported positive associations, the absence of potential cofounders such as developmental status and the variations in assessment procedures makes it difficult to draw robust conclusions.

## PHYSICAL ACTIVITY

There was inconclusive evidence of the associations between physical activity and blood lipids and social and emotional development. Three cross-sectional studies examined the relationship between physical activity and blood lipids. One found an inverse relationship with total cholesterol<sup>37</sup> and the other two reported a positive association with high-density-lipoprotein cholesterol (or “good cholesterol”).<sup>47,48</sup> Two studies (one cross-sectional and one experimental) investigated relationships between physical activity and social competence. In these studies, participation in a dance program or spending more time playing with same-sex peers improved social competence.<sup>49,50</sup> One study investigated the relationship between physical activity and emotional development and found that time spent in physical activity was related to teacher-rated emotional competence in boys but not girls.<sup>50</sup>

Overall, mixed evidence for the association of physical activity with health benefits in preschool aged children was found.<sup>3</sup> The difficulty in accurately measuring physical activity within this age group; the small and underpowered samples in many studies; and the fact that children are generally healthy and free from risk factors for chronic disease (as such, one would not expect to see variations in many of the health outcomes, certainly not enough to be influenced by behaviours such as physical activity) are possible explanations for the mixed evidence.<sup>3,4</sup> Although the evidence with younger children is limited, there is strong evidence showing associations between physical activity and health outcomes in older children and adults, therefore physical activity habits established within the early years are likely to promote later physical activity and health.

Based on these findings and those described in the other reviews,<sup>9-14</sup> the following recommendations were synthesized (Table 1).

Table 1: Physical activity recommendations for children under five from Australia and United Kingdom.

Australia <sup>3</sup>	United Kingdom Draft Guidance <sup>4</sup>
For healthy development in infants (birth to 1 year), physical activity should be encouraged from birth, particularly supervised floor-based play in safe environments.	Infants should be encouraged from birth to be physically active daily, particularly through floor-based play in safe environments.
Toddlers (1 to 3 years of age) and preschoolers (3 to 5 years of age) should be physically active every day for at least THREE hours, spread throughout the day.	Children of preschool age who are capable of walking unaided should be physically active daily for at least THREE hours.

While the empirical evidence does not suggest a prescribed amount of time, most of the observational and intervention studies reviewed suggested that “more physical activity is better” thus, the recommendations from Australia and the United Kingdom reflect more than the typical amount of daily movement (of around two hours per day of a typical 12-hour day).<sup>3,4</sup> The recommendation of three hours of physical activity per day is based on expert opinion and existing healthy outcome literature (as detailed above). The recommendations highlight that large amounts of time should be set aside daily for physical activity. Further, three hours allows for a possible decline in physical activity levels once young children attend primary school. It should also be noted that the recommendations do not specify any intensity of physical activity (i.e., whether the activity is light, moderate or vigorous), which aligns with young children’s natural intermittent and sporadic physical activity patterns.<sup>3,4</sup>

### **Research Gaps**

With the development of prescriptive physical activity recommendation from children aged birth to five, a number of research gaps remain.<sup>3,4</sup> Future research could include:

- Establishment of surveillance systems for assessing compliance with recommendations;
- Monitoring the awareness and uptake of the recommendations by stakeholders such as health professionals, child care workers and parents; and
- Development, implementation and evaluation of simple well-designed interventions to promote physical activity in young children.

### **Conclusions**

The development of prescriptive evidence-based physical activity recommendations for children under 5 years is imperative as it will facilitate monitoring and surveillance of the health and development of children. It will also help early years educational settings foster an inclusive and comprehensive educational environment from an early age, which arguably provides the best possible start for children. Establishing healthy physical activity habits from a young age, through implementation of evidence-based physical activity recommendations, will only be beneficial.

### **Implications for Parents, Services and Policy**

The development of physical activity recommendations for children from birth to 5 years will have several notable implications for parents, services and policy makers.<sup>3,4</sup> Prescriptive physical activity recommendations which are based on solid empirical evidence will:

1. Assist key stakeholders to understand the importance of physical activity for health benefits among young children;
2. Inform government policy in relation to health-promoting physical activity for children birth to 5 years of age;
3. Assist consumers, childcare workers and other health professionals to understand the importance of physical activity for health in children; and
4. Underpin and support health promotion activities and intervention by workers across a range of sectors and all levels of government.

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## Correlates of Physical Activity in Early Childhood

*TRINA HINKLEY, BA*  
*JO SALMON, PhD*

*Centre for Physical Activity and Nutrition Research (C-PAN),  
Deakin University, AUSTRALIA*

*(Published online January 13, 2011)*

### **Topic**

*Physical activity*

### **Introduction**

Physical activity is important for many health outcomes. In young children, physical activity has been negatively associated with weight status<sup>1-3</sup> and blood pressure,<sup>4</sup> and beneficial for bone health.<sup>5</sup> Physical activity during the early childhood period is also important as that is the time when children can learn and develop healthful behaviours,<sup>6-7</sup> such as physical activity, which can then support them throughout their lives. As discussed in the other papers on this topic, the amount of physical activity young children participate in varies widely across studies.<sup>8-13</sup> This suggests that some children may not have the opportunities or support they need to be active. It is therefore imperative to understand the correlates of, or factors which might influence, physical activity in early childhood so that support can be given to those children in need.

### **Subject**

Correlates of physical activity in young children have been identified across a number of settings and contexts. For instance, characteristics of the child's demographic and biological characteristics, social and physical environments have all been shown to be associated with young children's physical activity.<sup>14</sup> Developing knowledge of such correlates is necessary so that interventions to increase physical activity can target those factors.

### **Problems**

Until recently, it was generally assumed that young children were "naturally physically active." In the last 10 years or so, it has become evident that many young children do not participate in sufficient physical activity for health. Research has begun to emerge about the correlates of physical activity in young children.

Young children spend their time in a range of different settings and contexts. This includes the home with parents or other adults, child care settings with trained or untrained staff, preschool or kindergarten environments where they may be exposed to a variety of different programs, and local neighbourhood environments such as

playgrounds and shopping centres. The correlates which might influence physical activity behaviours also vary across those settings and contexts. For instance, in the home environment having someone to play with might be important, whereas at preschool having more outdoor space might help to support physical activity. Identifying correlates across those settings is challenging, and compounded by the child's inability to accurately self report given their young age and lack of cognitive development. Parents may report on behalf of the child, however, there may be large amounts of time where the child is not in the parent's company (for instance, while the child is at preschool, kindergarten or child care) and therefore the parent is unable to report on the child's behaviour or potential correlates during those periods.

Compounding the identification of physical activity correlates is the diversity of measurement methods which have been employed to measure physical activity in young children. They include direct observation, parent-proxy report, [\*accelerometry\*](#) and pedometry. These instruments measure different aspects of physical activity and therefore differences in identified correlates may be evident.

### **Research Context**

Correlates of physical activity are often studied in cross-sectional studies. That type of study design does not allow researchers to make conclusions about causality, that is, researchers cannot definitively state that the correlate being studied directly influences physical activity, only that it is associated with the behaviour. Additionally, many studies which investigate correlates of physical activity in young children use relatively small samples, often fewer than 300 children, and investigate a small range of potential correlates. As preschool children may be active across a range of environments, it is also important to identify potential correlates in those environments. More recently, a few cohort studies have begun to emerge. Such studies allow the same group of children to be followed over a period of time, and researchers can then make more appropriate conclusions about causality between correlates and behaviour.

### **Key Research Questions**

Key questions include identifying which contexts or settings correlates may operate in, which factors within each of those contexts or settings might be important, and whether correlates vary by characteristics of the child, such as sex, ethnicity or weight status.

### **Recent Research Results**

A recent review of the correlates of young children's physical activity reported that young children are more active if: they are boys, their parents participate in physical activity and are active with their child, and they spend more time outside.<sup>14</sup> Age was found to have no association with young children's physical activity.<sup>14</sup> Although a total of 39 potential correlates had been examined, most had been investigated in too few studies to be able to draw conclusive findings.

Other recent research has investigated the environment at preschools, kindergartens and child care centres. For instance, studies have reported that the ground surface (i.e., grass, asphalt, etc), pathways, play structures and open spaces have been shown to correlate

with physical activity.<sup>15</sup> Fewer children per square metre of outdoor space, shorter recess time,<sup>16</sup> active opportunities, fixed and portable play equipment, and staff trained in physical activity for young children<sup>17</sup> have also been found to promote physical activity.

### **Research Gaps**

Little is known about social influences on young children's physical activity. For instance, does parent encouragement and logistic support correlate with higher levels of physical activity in young children as it does for older children? Similarly, with the exception of time outside, little is known about how other child behaviours, such as television viewing or other screen-based behaviours, might influence their physical activity. Cohort and intervention studies are required to identify the direction of causality of potential correlates. As research in this area has primarily relied on small, cross-sectional studies, primarily in the United States and the United Kingdom some potentially important correlates may have not yet been identified. Additionally, using objective measures of physical activity and standardized protocols for analyzing and interpreting data would aid in comparability of findings across studies. A more comprehensive understanding of children's innate psychological and cognitive drives, although difficult to capture in such a young population, may also facilitate a more comprehensive understanding of children's behaviours and support individual level intervention strategies. Virtually no research has been undertaken in children younger than 3 years of age.

### **Conclusions**

Although physical activity is important for health and development of young children, not all children are meeting the physical activity recommendations. There is consistent evidence that boys are more active than girls, that parents who support and participate in physical activity with their child have more active children, and time spent outdoors is associated with higher levels of physical activity. Further research that follows changes in children's physical activity as they age and examines factors that influence these changes is required. Very few intervention studies that assess the effectiveness of strategies to promote young children's physical activity have been tested, particularly among children younger than 3 years.

### **Implications for Parents, Services and Policy**

#### *Implications for parents*

- a) Young children need parents' and other adults' support to access environments where they can be physically active.
- b) Young children need to spend time outdoors. Ideally, this should be several hours every day.
- c) Parents should model healthy physical activity behaviours by being active themselves and also interacting with their children in physical activities such as bike riding, walking and active play.
- d) Parents need to be aware that their daughters need to spend just as much time and energy being physically active as their sons.

## PHYSICAL ACTIVITY

### *Implications for services*

- a) Preschools, kindergartens and child care centres should be encouraged to provide children with ample time outdoors on a daily basis.
- b) If inclement weather inhibits active outdoor play, centres should ideally provide children with opportunities to be active indoors.
- c) Staff should be educated and provided with training in young children's physical activity, including appropriate activities and strategies to support healthy levels of physical activity for the children in their care.
- d) Girls may need sex-appropriate opportunities to be active, as research shows that they are consistently less active than their male counterparts.
- e) Physical environments at centres should include a range of activity opportunities to support children's physical activity including a variety of portable and fixed play equipment and adequate shading.

### *Implications for policy*

- a) Establishing programs to raise awareness of the factors which parents and other care-givers can utilize to support young children's physical activity should be a national priority for every country.
- b) Governmental policies covering preschools, kindergartens and childcare centres should include requirements for minimum amounts of time outside as well as evidence-based programs which support physical activity, with a particular focus on sex-specific activities to ensure that girls also engage in healthful levels of physical activity.

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## **Sedentary Behaviour Recommendations for Early Childhood**

*ANTHONY D. OKELY, EdD*  
*RACHEL A. JONES, PhD*

*University of Wollongong, AUSTRALIA*

*(Published online January 13, 2011)*

### **Topic**

*Physical activity*

### **Introduction**

Early childhood has been identified as a critical time in the development of sedentary behaviours as data shows that these behaviours track strongly into childhood and adolescence.<sup>1,2</sup> Some sedentary behaviours are important for healthy child development (e.g., play-based activities). These are not the focus of this review. This review is more concerned with sedentary behaviours such as television viewing and other electronic media use as this is where most of the evidence exists. It is also important to note that sedentary behaviour is not the opposite of physical activity; that is, just because a child is physically active does not mean he/she does not spend excessive time in sedentary behaviours.

To determine if an evidence base exists for which to construct sedentary behaviour recommendations for young children (defined in this context as 0-5 years of age), it is important to review the evidence to ascertain if there are any health consequences associated with sedentary behaviour in this age group and if so, is there a “dose” of sedentary behaviour above which these health consequences become more pronounced?

### **Subject and Research Context**

Sedentary behaviour is defined as behaviours that encompass sitting or lying as the dominant posture and result in very low levels of energy expenditure.<sup>3</sup> They are multi-faceted and include screen time (television, DVD, computer), motorized transportation, and sitting to read or complete homework.<sup>3</sup> The majority of sedentary behaviour research in young children has focused on television viewing. While this is an important sedentary behaviour, it is only one of a range that can be undertaken. It is becoming increasingly clear that it is the total time spent in sedentary behaviour, and the length and number of the bouts spent being sedentary, that are important risk factors for health in adults<sup>4,5</sup> and adolescents.<sup>6,7</sup> As such, it is important to examine the health evidence for this behaviour in early childhood and determine if there is enough evidence or consensus to make recommendations for parents, service planners and providers and policy makers within the early childhood sector.

### **Problems and Key Research Questions**

Up to the end of 2010, Australia was the only known country to have evidence-based national recommendations for sedentary behaviour for children aged 0 to 5. However, Canada and the United Kingdom are currently developing similar recommendations. A number of recommendations endorsed by bodies such as the American Academy of Pediatrics<sup>8</sup> exist, however, these are based on expert consensus rather than scientific evidence. The aim of this chapter is to summarize the evidence to provide the best possible basis to devise sedentary behaviour recommendations for children aged 0 to 5 years. The key research questions addressed in this chapter are:

1. Is there any evidence that sedentary behaviour is associated with health and developmental outcomes in early childhood?
2. Based on the evidence, how much time should young children spend in specific sedentary behaviours?
3. Do these recommendations differ for different stages of early childhood (infants, toddlers, and preschoolers)?

### **Recent Research Results**

Strong evidence from at least 10 cross-sectional studies show that time spent in sedentary behaviour is positively and significantly associated with body fatness. Two studies reported that preschoolers who spent more than two hours per day watching television had a greater likelihood of being overweight as children. With regards to respiratory health, it has been shown in one longitudinal study that children who watched more than two hours of television per day at 3 years of age were nearly two times more likely to develop asthma by age 11. Conversely, children who watched less than two hours per day at this age had better skeletal health at age seven compared with those who watched more than two hours per day. Cross-sectional evidence has found that time spent watching television was associated with a greater intake of high-energy foods. Four longitudinal studies have reported a positive relationship between time spent watching television under the age of five and lower cognitive development, academic achievement, language skills, and short-term memory one to three years later. Further, three cross-sectional studies found an inverse relationship between television time and language development. Finally, time spent watching television at ages 1 and 3 has been shown to significantly predict attention problems at age 7.

Based on the evidence provided, and consensus among experts, the following sedentary behaviour recommendations for early childhood are proposed: (Note: these are consistent with those recently developed in Australia.<sup>9</sup>)

1. Children younger than 2 years of age should not spend any time watching television or using electronic media.
2. For children 2 to 5 years of age, sitting and watching television and the use of other electronic media should be limited to less than one hour per day.
3. Infants, toddlers and preschoolers should not be sedentary, restrained or kept inactive for more than an hour at a time, with the exception of sleeping.

### Research Gaps

As a result of reviewing the evidence, there are several gaps in the current research that need to be addressed. These are:

- Is the relationship between sedentary behaviour and health mediated by other associated health behaviours such as an increase in energy intake as a result of increased snacking and exposure to food advertising?
- Does sedentary behaviour displace physical activity?
- Is the relationship between sedentary behaviour and fatness mediated by participation in moderate-to-vigorous intensity physical activity? Since none of the studies reviewed here controlled for physical activity, and these are independent behaviours not necessarily inversely correlated with each other, it is not known if the relationships that have been found between sedentary behaviour and some of the outcomes are a result of higher levels of sedentary behaviour or lower levels of physical activity or both.
- It is not possible to determine if the amount of time spent sitting watching television or the content of the programs viewed is what explains the relationship between television viewing and some cognitive and self-regulation outcomes.

In addition:

- More high quality evidence from experimental and longitudinal studies which have a measure of sedentary behaviour during early childhood is needed.
- More studies that use an objective measure of sedentary behaviour such as [\*accelerometry\*](#) or inclinometry are needed when examining overall time spent in sedentary behaviour or sitting.
- Most of the evidence is for television viewing. More evidence is needed on the relationship of other sedentary behaviours, especially electronic media use, with health and developmental outcomes.
- Better understanding of the maximum amount of time that young children can spend in total sedentary time and in specific sedentary behaviors (such as watching television and other screen-based activities) before the prevalence of health consequences and adverse developmental outcomes increases.

### Conclusions

For children aged 2 to 5 years, spending more than two hours per day watching television or using other electronic media may be detrimental to a wide range of health, developmental and educational outcomes. The evidence is strongest for poorer cognitive outcomes and higher body fatness. This latter point is important given the high prevalence of overweight and obesity among pre-school children, especially in developed countries.<sup>10</sup> As time spent in sedentary behaviour (especially screen time) increases as young children transition into formal schooling<sup>11</sup> and throughout childhood and adolescence,<sup>12,13</sup> it is important to minimize time spent in these behaviours prior to school to maximize compliance with the recommendations for school-aged children of no more than two hours of screen time per day. For children under two, there is no evidence that watching television or using electronic media has educational or health benefits; moreover, there is some evidence that it may delay or reduce some cognitive outcomes such as language and word vocabulary. Children aged 0-5 should not be sedentary for

more than one hour at a time, except while sleeping. This includes any situation where the child is predominantly inactive (that is, not standing up or moving).

### **Implications for Parents, Services and Policy**

To assist parents, service providers and policy makers in meeting the recommendations around television and other electronic media, it is advised to not have televisions or game consoles in children's bedrooms or child care centres, not eat meals in front of the television, and to turn the television off when it is not being watched. Parents and service providers should also set limits and rules for their own viewing as well as for children to role model correct behaviours to children.

To help with meeting the recommendation around not being sedentary for more than an hour at a time, try to break up long car trips by stopping at a park or playground for 10-15 minutes. Also try to get children to walk short distances rather than sit in a pram or stroller or alternate walking and sitting for longer journeys.

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# Interventions to Promote Physical Activity in Young Children

*STEWART G. TROST, PhD*

*Oregon State University, USA*

*(Published online January 12, 2011)*

## **Topic**

*Physical activity*

## **Introduction**

Adequate participation in physical activity during early childhood is considered essential for normal growth and development.<sup>1</sup> Physical activity is also an important contributing factor in the prevention of overweight and obesity in young children.<sup>2,3</sup> In recognition of the importance of regular physical activity, the National Association for Sport and Physical Education (NASPE) in the United States has issued guidelines recommending that all children from birth to age five engage in daily physical activity that promotes health-related fitness and movement skills.<sup>4</sup> Similar recommendations have been issued by clinicians, researchers and early childhood education stakeholders in Canada, Australia and the United Kingdom. Yet, despite the importance of regular physical activity, objective monitoring studies conducted in North America, Australia and the United Kingdom suggest that young children accumulate relatively small amounts of moderate-to-vigorous physical activity daily.<sup>5</sup>

## **Subject**

The widespread problem of physical inactivity, taken alongside the continued rise in the prevalence of obesity in children under the age of 5, underscores the need for effective but readily translatable policies and programs to promote physical activity in young children. This brief review will summarize what is currently known about interventions to promote physical activity in early childhood settings.

## **Problem**

Relatively few interventions to promote physical activity in children under 5 have been rigorously evaluated. Consequently, we have very limited scientific evidence to tell policy makers, service planners and providers what works and what doesn't work when it comes to getting young children more physically active.

## **Research Context**

Because a large percentage of children under the age of 5 are in some type of regular child care arrangement, intervention studies have been primarily implemented and tested in center-based early childhood education settings.<sup>6</sup> Notably, however, physical activity interventions targeting other types of child care settings such as family child care homes are beginning to appear in the research literature.<sup>7</sup>

### **Key Research Questions**

Published studies in this area have primarily addressed the question of whether curricula emphasizing structured physical activity, movement skill training or reductions in television watching are effective at increasing physical activity. Other studies have investigated the impact of specific environmental or policy changes on physical activity levels during child care.

### **Recent Research Results**

To date, eight studies have employed experimental study designs to evaluate interventions to increase physical activity in young children. Five studies tested the effectiveness of specialized physical activity curricula or movement training programs,<sup>8-12</sup> while the remaining three studies evaluated the impact of environmental or policy changes on physical activity level.<sup>13-15</sup>

In the five studies testing curriculum-based approaches, activity sessions ranged from highly prescriptive exercise training regimens (jumping, hopping, skipping, circuit training) to developmentally-appropriate, physically active imagination games and skits. Two investigations included strategies to improve fundamental movement skills.<sup>9,12</sup> The planned activity sessions or lessons were implemented on-site by research staff and/or trained teachers. Children participated in the activity sessions between three and six days per week. The duration of the entire program ranged from 14 weeks to 12 months.

In general, the curriculum-based approaches were not successful in promoting physical activity in young children. Of the five curriculum-based studies identified, only two reported significant improvements in physical activity.<sup>8,9</sup> However, both of these investigations could be regarded as controlled exercise training studies that implemented highly structured and repetitive physical activity regimens. The three studies reporting null findings trained child care staff to implement developmentally-appropriate games and activities that provided opportunities for moderate-to-vigorous physical activity and movement skill development.<sup>10-12</sup> The failure of these studies to increase physical activity may be related to the program's focus on obesity prevention rather than physical activity per se. It is also possible that the interventions were insufficient in length and intensity to significantly change behaviour; however, two of the three studies reported significant reductions in body fatness. Considering the positive impact on fatness, it is possible that the measurement protocols used to quantify physical activity behaviour may not have been sufficiently sensitive to detect changes in physical activity.

Although few in number, studies evaluating environmental or policy interventions to promote physical activity have reported mostly positive findings. The addition of portable playground equipment and training teachers to incorporate physical activity into their usual classroom lessons resulted in significant increases in objectively measured daily physical activity.<sup>13,14</sup> Notably, providing an additional 60 minutes of outdoor recess or free play each day did not result in significant increases in moderate-to-vigorous physical activity.<sup>15</sup>

### **Research Gaps**

To advance our understanding in this area, some key research questions would include: 1) What are the key behavioural settings for promoting physical activity in young children? 2) Are programs to promote movement or physical activity in infants and toddlers warranted, and if so, what settings and strategies would be effective? 3) Are modifications to the child care environment such as incorporating natural playground design and improving service provider's physical activity leadership skills effective in increasing physical activity in young children? 4) Are structured physical activity programs led by physical education specialists or community-based physical activity providers feasible, sustainable, and effective in promoting physical activity in other behavior settings? 5) How can child care providers engage and motivate parents and other caregivers to promote and support physical activity at home?

### **Conclusions**

Relatively few interventions to promote physical activity in children under 5 have been rigorously evaluated. The available evidence, although limited, suggests that simple modifications to the outdoor play environment such as the provision of "off the shelf" portable play equipment can increase physical activity behaviour. Additionally, training teachers to incorporate movement into the standard classroom curriculum appears to be effective in increasing physical activity levels during the preschool day. Nevertheless, because these results were obtained in small feasibility studies, such findings require replication in larger cluster randomized trials.

To date, providing curricula that offer opportunities for developmentally-appropriate moderate-to-vigorous active play and fundamental movement skill development has not been effective in promoting physical activity. It may be that such approaches are simply ineffective and that alternative strategies require exploration. Nonetheless, it should be noted that these studies: 1) focused on obesity prevention rather than physical activity, 2) provided activity sessions that were relatively brief in duration (~ 30 min) and low in frequency (three days per week); 3) were implemented over a relatively short time period (12 - 24 weeks); and 4) employed physical activity measurement protocols with limited sensitivity to detect changes in physical activity behaviour.

Adult-led physical activity programs delivering highly structured exercise training sessions on a daily basis resulted in higher levels of physical activity. However, it is important to note that these studies were primarily exercise training studies in which physical activity was the factor being changed, not the outcome of the change. Thus, it is questionable whether these findings can be generalized to public health approaches to promoting physical activity in young children.

### **Implications for Parents, Services and Policy**

For policy makers and service providers, the extant research literature provides relatively little guidance as to what approaches are effective in promoting physical activity in young children. The research suggests that training child care staff to increase opportunities for physical activity in the classroom and during recess may be an effective strategy. From a public health perspective, the focus on child care provider training is particularly

attractive, since the trainings could be mandated as a licensure requirement and delivered through existing child care worker education and training networks.

Based on the evidence, policy makers and service providers should be wary of adopting stand-alone curricula offering structured physical activity and movement skill training, as there is currently little evidence to support their effectiveness. However, it should be noted that structured programs are not likely to do harm to young children; and in practice, such programs may offer substantial benefit to children when they are implemented in a responsible, developmentally-appropriate manner.

While the evidence related to physical activity interventions in child care settings is not definitive, it is well-established that parents play a significant role in shaping and supporting their children's physical activity behaviour.<sup>16,17</sup> In the absence of evidence-based programs to promote physical activity in child care settings, parents must be willing to take responsibility for encouraging and supporting their children's physical activity behaviour. The development of programs to educate and support parents in this endeavour should therefore be a priority.

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## Physical Activity in Infants and Toddlers

*GREET CARDON, PhD*

*EVELINE VAN CAUWENBERGHE, PhD-Student*

*ILSE DE BOURDEAUDHUIJ, PhD*

*Department of Movement and Sports Sciences, Ghent University, BELGIUM*

*(Published online January 13, 2011)*

### **Topic**

*Physical activity*

### **Introduction**

Globally, at least 20 million children under the age of five were estimated to be overweight in 2005.<sup>1</sup> The paediatric obesity epidemic has heightened interest in physical activity and sedentary behaviours during early childhood as correlates of energy balance and body composition. Physical activity participation in young children also plays an integral role in their overall development, including decreased likelihood of exhibiting cardiovascular disease risk factors and improved bone health, fundamental motor skills and social and psychological development.<sup>2</sup> Moreover, early childhood is one of the critical time periods for the establishment of sedentary and physical activity behaviours.<sup>3</sup> However, upon a review of the evidence by Reilly,<sup>4</sup> studies of objectively measured physical activity and sedentary behaviour in preschool children show that levels of physical activity are typically low and sedentary behaviour high.

### **Subject**

While the interest in physical activity in preschool children, incorporating ages 3–5 years, has increased over the past decade, studies of physical activity levels and sedentary behaviours in children under the age of three are very scarce.

### **Problems**

Data on physical activity levels and sedentary behaviours from 3 to 5 year old children may not be transferable to younger children since the age range 0–5 years encompasses three developmental periods, each of which is characterised by quite different physical activity patterns.<sup>5,6</sup>

The infant period generally encompasses the first 12 months of life. Activity or movement in the first 6 months is restricted to reaching and grasping objects, turning of the head toward a stimulus, and movement of the arms and legs. The second 6 months is characterised by the learning of rudimentary movement skills. The developmental stage from 1 to 3 years of age is often described as the toddler period. Around 1 year of age, children commence walking. With this increased opportunity for exploration and

learning, toddlers develop locomotor skills such as running, jumping and hopping. Further, manipulative skills emerge in the toddler years. The pre-school period incorporates ages 3–5 years and is characterised by further development of stability and locomotor and manipulative skills.

Next to differences in activity patterns between 3 to 5 year olds and younger children, estimates of daily physical activity in infants and toddlers are more likely to be influenced by daytime sleeping patterns than in preschool children.<sup>6</sup>

### **Research Context**

The literature was searched for studies evaluating physical activity levels and sedentary behaviours in healthy infants and toddlers, thus in children under the age of three.

### **Research Results**

Only two studies could be located, evaluating physical activity levels in this young age group. Gubbels et al.<sup>7</sup> observed 75 two-year-olds and 100 three-year-olds at nine Dutch child care centres with the Observational System for Recording Physical Activity in Children -- Preschool Version.<sup>8</sup> A large proportion of the observed activities (59.4% of the indoor and 31.2% of the outdoor observations) were classified as sedentary, while only 5.5% of the indoor and 21.3% of the outdoor observations were classified as moderate and vigorous physical activity. There were no significant differences in mean activity intensity level between boys and girls, or between 2- and 3-year-olds.

In the GENESIS study,<sup>9</sup> executed in Greece, physical activity data from 207 one- to two-year-olds and 500 two- to three-year-olds were collected by parental report. Parents reported 1.45 hours/week of light to vigorous physical activity in the infant boys and 1.05 hours/week in the infant girls. In the toddlers, 1.51 and 1.21 hours/week of light to vigorous physical activity were reported in the boys and girls respectively. Typical physical activities reported were playground recreational activities and taking walks with parents.

Since only two studies could be located and taking into account that parental report is of low accuracy for measurement of physical activity in young children,<sup>6</sup> evidence-based conclusions cannot be drawn. However it can be concluded that there are some indications that the low activity levels of preschoolers are also present in children under the age of three.

Similarly, only a few studies could be identified of sedentary behaviors in infants and toddlers. Zimmerman et al.<sup>10</sup> performed a telephone survey in 1009 parents of U.S. children aged 2 to 24 months to determine their television-, DVD- and video-viewing habits. By 3 months of age, about 40% of children regularly (on average 40 minutes per day) watched television, DVDs or videos. By 24 months, this proportion rose to 90%. The median age at which regular media exposure was introduced was 9 months. Vandewater et al.<sup>11</sup> reported survey data from a representative sample of U.S. parents of children aged 0 to 6 (N =1051) in 2005. They found that 63% of the 0- to 2-year-olds watched television on a “typical day,” for on average 1 hour and 15 minutes.

Approximately 4% of 0- to 2-year-olds used the computer on a “typical day” and those who did, spent an average of 50 minutes at the keyboard.

Certain et al.<sup>12</sup> reported survey data from a large sample of U.S. parents (N=3556). According to the parental reports, 17% of 0- to 11-month-olds and 48% of 12- to 23-month-olds watched television, while the American Academy of Pediatrics recommends that children younger than 2 watch no television.<sup>13</sup> In the 24- to 35-month-olds 41% watched more than two hours per day, while the American Academy of Pediatrics recommends that children, 2 years and older, limit their time with entertainment media (television, video games, the Internet) to two hours per day.<sup>13</sup>

Common media use at very young age was also confirmed in a non-U.S. sample. In the GENESIS study<sup>14</sup> it was found that 11.1 % of the 1- to 2-year-old children view television longer than two hours/day.

From the different studies reviewed here it can be concluded that TV viewing is already common in infants and toddlers. This behaviour may displace light physical activity, it is often also associated with snacking, posing a double risk for children.<sup>15</sup>

### **Research Gaps**

To gain a comprehensive understanding of physical activity and sedentary behaviour during the toddler and infant years more research is needed in children under the age of three. Due to the short intermittent bursts of activities of young children,<sup>6,16</sup> only direct observation or objective measures, like [accelerometers](#), should be used to define activity levels in infants and toddlers. However, although the validity and feasibility of accelerometers have been examined in preschoolers, similar studies are lacking in toddlers and infants.<sup>6</sup> Two pilot studies examined the use of accelerometers in 1-year-olds. Cardon et al.<sup>17</sup> showed that accelerometer-based physical activity measurements are already feasible in 1-year-olds. Trost et al.<sup>18</sup> determined [Actical and ActiGraph cut-points](#) for sedentary, light and moderate-to-vigorous physical activity in toddlers by videotaping 22 toddlers (eight boys, 14 girls) while wearing an accelerometer during a randomly selected 15-minute free-play period at child care. Studies comparing the accuracy of different types of accelerometers, differing monitor placements, accelerometer count thresholds and preferable time sampling intervals also seem critical for understanding how best to measure movement in young children. Such analyses might also consider the characterisation of movement during the different stages of development (infant, toddler or preschooler).<sup>6</sup> Moreover, the utility of [accelerometry](#) systems capable of detecting body posture (e.g., time spent sitting or standing) should be investigated in young children. These monitors may help evaluate sedentary behaviour in infants and toddlers as they can provide information, beyond the capabilities of conventional accelerometers.<sup>19</sup>

### **Conclusions**

While there is evidence that physical activity is important for infants and toddlers, it can be concluded that very little is known about their (in)activity levels. The limited evidence shows that very young children spend a large proportion of time sedentary, that television

viewing is already common in infants and toddlers and that the time spent in moderate to vigorous physical activity is limited.

Further research is advocated to improve understanding of basic aspects of physical activity and sedentary behaviours in infants and toddlers. Meanwhile, efforts to promote physical activity and to minimize sedentary behavior (e.g., media use) in infants and toddlers are advocated.

### **Implications for Parents, Services and Policy**

If policies are to be designed and disseminated for the purpose of increasing physical activity and decreasing sedentary behaviour among infants and toddlers, then those policies should be developed on the basis of an improved understanding of basic aspects of physical (in) activity in these age groups.

Young children spend the greater part of their time at home, with their parents. Consequently, parents can have a strong influence on their child's health behaviour. Parents control the exposure to physical activity opportunities, act as role models and can use specific parenting practices, such as rules on television viewing.

Besides the home environment, the child care environment may play an important role in achieving adequate physical activity levels for young children since in many countries most children spend extensive time in child-care settings. Recently Gubbels et al.<sup>20</sup> showed that child care attendance at the age of 1 and 2 years was positively associated with body mass index (BMI) at 2 years, and a greater increase in BMI between these ages. Benjamin et al.<sup>21</sup> also found that infants who attended child care in someone else's home during their first 6 months of life, had greater measures of adiposity at 1 and 3 years of age.

Moreover Gubbels et al.<sup>7</sup> showed in 2- and 3-year-olds that activity opportunities in the physical environment and prompts by staff and peers were positively related to physical activity intensity in child care, while group size negatively related to activity intensity. These results indicate a need for additional exploration of physical activity practices in child care and identification of opportunities for intervention.

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## Physical Activity in Early Childhood: Topic Commentary

*JOHN J. REILLY, PhD*

*University of Strathclyde, Scotland, UNITED KINGDOM*

*(Published online January 13, 2011)*

### **Topic**

*Physical activity*

### **Introduction**

The six contributions which make up the topic of physical activity in early childhood provide critical summaries of the recent research evidence in this area from subject specialists.<sup>1-6</sup>

Physical activity is important to many aspects of child health and development, and increasing levels of physical activity would have many benefits, both in the short term (for the child) and the longer term (when the child becomes an adult).<sup>7</sup> Traditionally, early childhood has been seen as a period characterized by high levels of physical activity: young children have been regarded as naturally physically active, and have been described in textbooks as “supercharged dynamos.” Parents and health and educational professionals who work with young children tend to perceive that their levels of physical activity are very high, and parent reports usually overestimate levels of childhood physical activity. The recent research evidence gives cause for concern that levels of physical activity in early childhood are typically much less than optimal. The contributions in this chapter also reflect increasing evidence in the scientific literature that sedentary behaviour, particularly screen time/electronic media use, starts early in life and exceeds recommended levels.

For modern children – in the Western world, at least – it is clear that the “digital childhood” begins early, and concerns over levels of physical activity and sedentary behaviour (which may be independent of physical activity i.e. a child could be sufficiently active but also very sedentary) form the background to this chapter.

### **Research and Conclusions**

Cardon and colleagues<sup>1</sup> summarize the research evidence on physical activity and sedentary behaviour in infants and toddlers. All authors contributing to this topic provide a list of research gaps, but these are greatest for infants and toddlers. Cardon and colleagues<sup>1</sup> note the potential for objective methods such as [accelerometers](#) to provide the kind of insights into physical activity in infants and toddlers that they have provided for pre-school children over the past decade. It is not clear precisely when or how unhealthy levels of physical activity and sedentary behaviour habits are established, but

the evidence synthesized by Cardon and colleagues<sup>1</sup> suggests that they may become established well before the preschool period.

Cliff and Janssen<sup>2</sup> summarize the evidence-obtained using objective measurement methods such as researcher direct observation and [accelerometry](#) on usual levels of physical activity among young children. Most of the evidence is from children in the preschool age range (3-5 year olds), and the authors note that much of it is difficult to interpret. Differences in methods used between the various studies have produced marked differences in apparent levels of physical activity. Nonetheless, on the whole the evidence reviewed by Cliff and Janssen<sup>2</sup> suggests that usual levels of physical activity are typically lower than those being recommended in recent evidence-based guidelines.<sup>3</sup>

Jones and Okely<sup>3</sup> review recent recommendations on levels of physical activity in early childhood. While early life physical activity recommendations have been available for some time, it is only recently that enough evidence has accumulated to allow these to become evidence-based, derived from a rigorous process of systematic review and formal critical appraisal of the literature.<sup>3</sup> For toddlers and pre-schoolers, three hours per day of physical activity is recommended by the recent Australian Department of Health and Ageing guidelines; these guidelines also recommend that age-appropriate physically active play be encouraged from infancy.<sup>3</sup>

Okely and Jones<sup>4</sup> review recent recommendations on levels of sedentary behaviour in early childhood, noting that most of the literature is on screen-time. Screen exposure risks a wide range of harms for child health and development, and there is now sufficient evidence for evidence-based recommendations to restrict screen time from infancy to the preschool period.<sup>4</sup> It is of particular concern that typical levels of exposure to screen-time are typically much higher than recommended, even in infants and toddlers.<sup>1,4</sup>

The final two contributions in the chapter provide hope that interventions to promote physical activity in early childhood are worthwhile. Hinkley and Salmon<sup>5</sup> review the evidence on the factors which influence levels of physical activity in early childhood, and most of the evidence is from 3-5 year olds. Identifying modifiable factors (e.g., parenting habits, environmental factors such as the design of childcare facilities) should help inform future interventions. Evidence on non-modifiable factors (e.g., age or gender) might help when planning how to 'target' interventions. Hinkley and Salmon<sup>5</sup> demonstrate the importance of empirical research evidence in this area, because a number of the research findings to date have been counter-intuitive. Trost<sup>6</sup> reviews the evidence on interventions aimed at increasing overall levels of physical activity in early childhood, or at increasing levels of physical activity in childcare. The evidence base is limited, but increased physical activity can produce beneficial changes in body fatness of children. The interventions to date can be regarded as promising, and 'best bets' in interventions have been identified. It is clear that future interventions have a useful foundation to build on.

## **Conclusion**

In summary, the topic provides a critical summary of current scientific evidence on physical activity and sedentary behaviour in early childhood. It highlights concerns that

levels of usual physical activity and sedentary behaviour in young children are inconsistent with optimal health and development, identifies a wide range of research priorities, and provides a number of useful pointers to parents, health and education professionals and policymakers.

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